

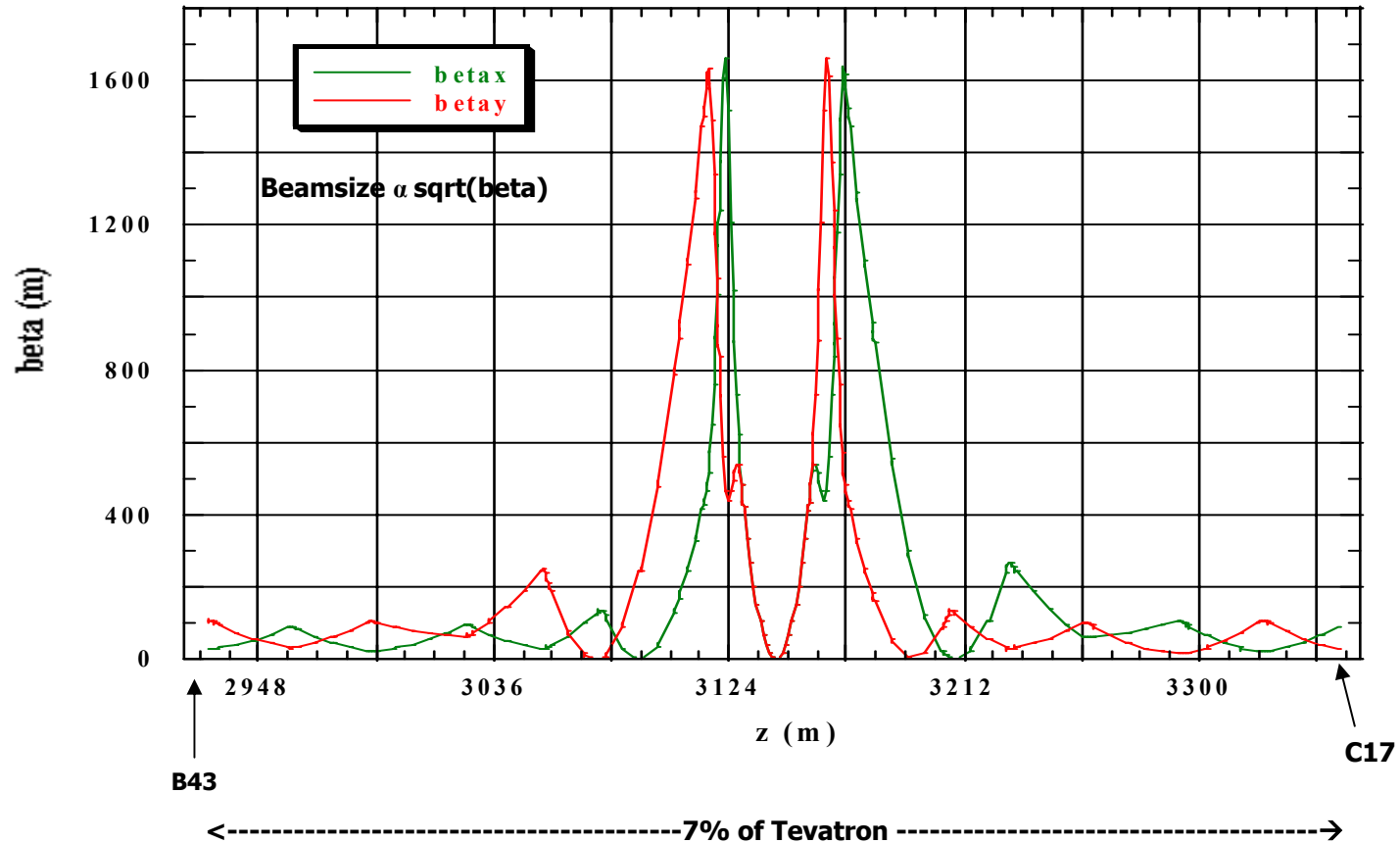
# **Progress on C0 IR Development**

**Mike Church**

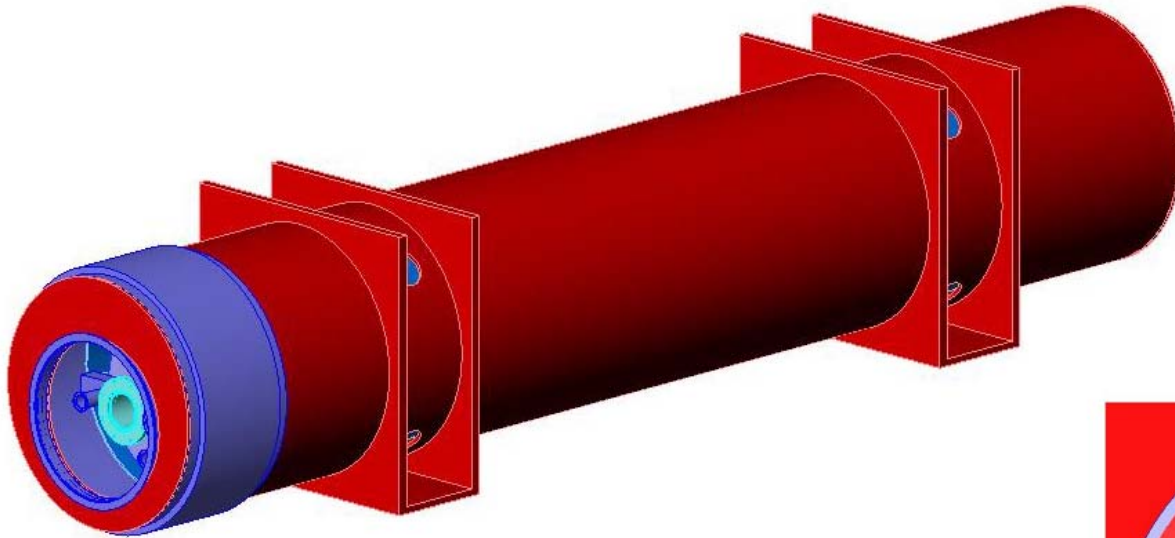
**FNAL**

**12/13/03**

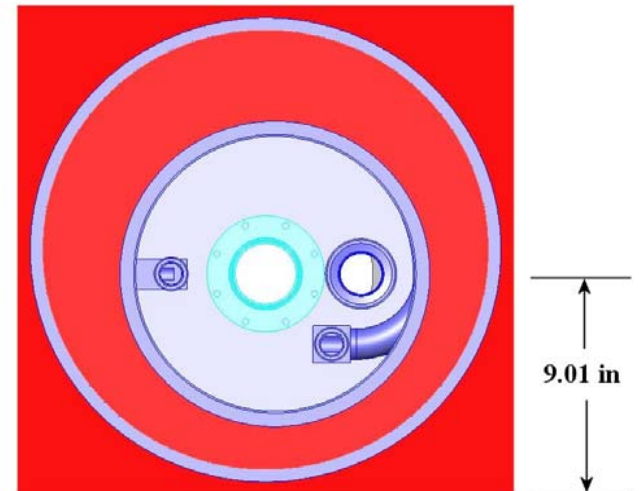
## C0 Low Beta Lattice (in perspective)



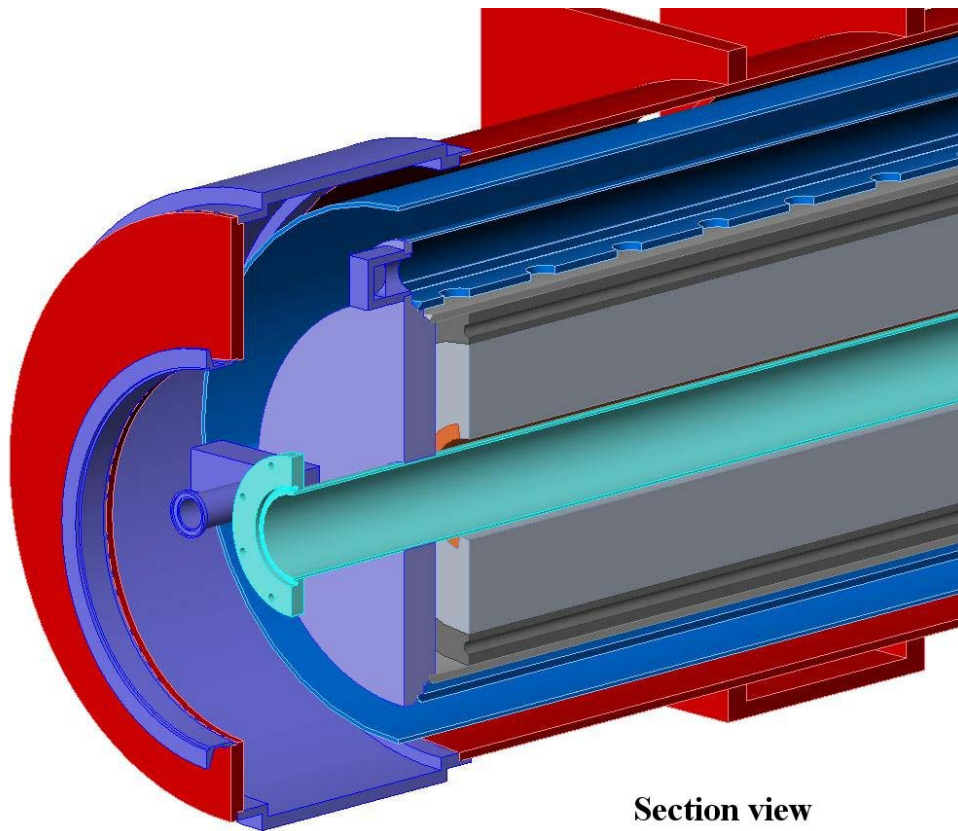
# LB Quad



Courtesy T. Nicol



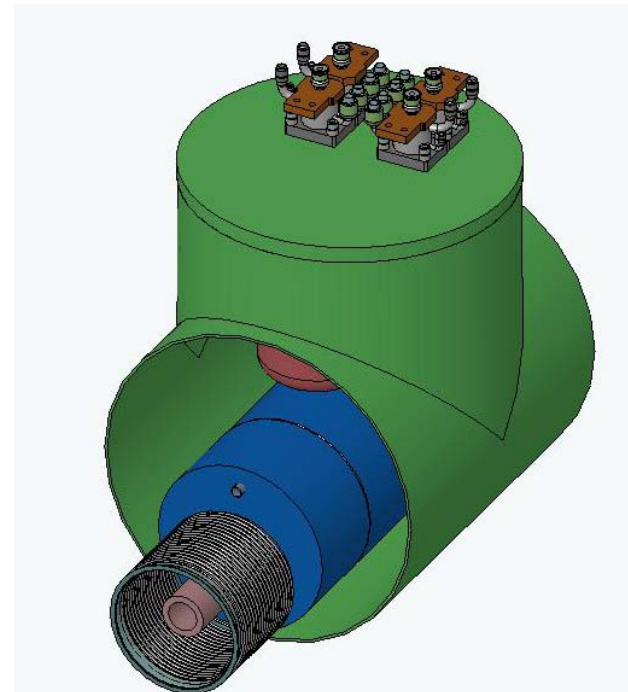
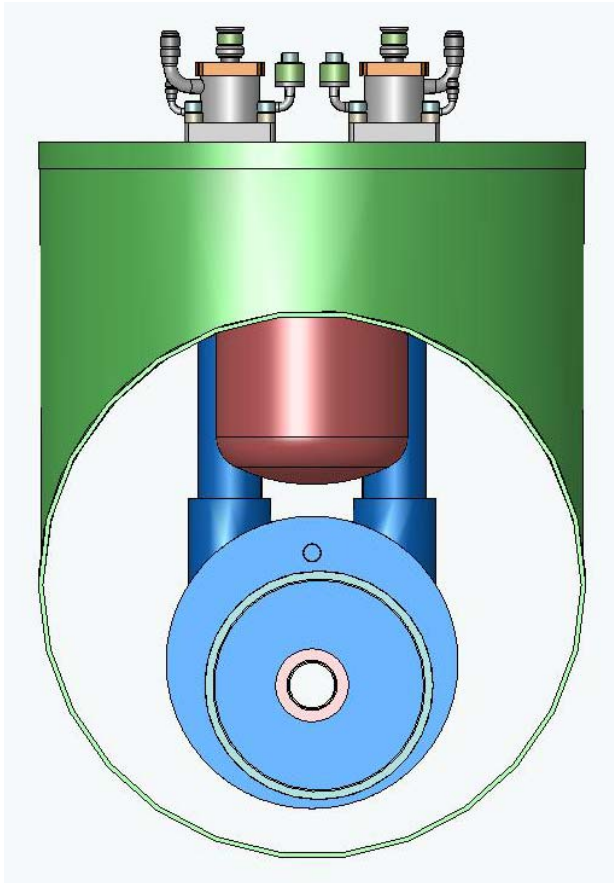
# LB Quad End Design



Section view

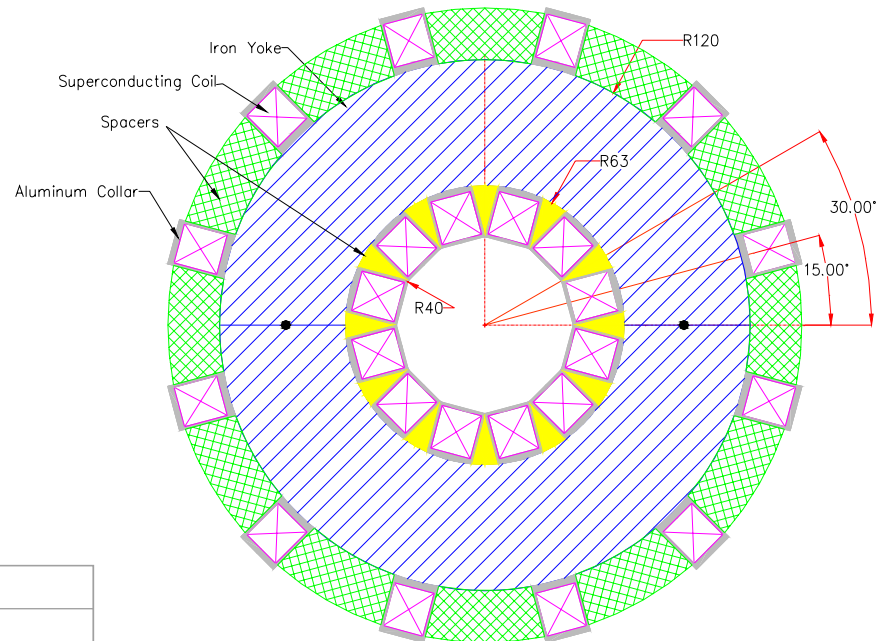
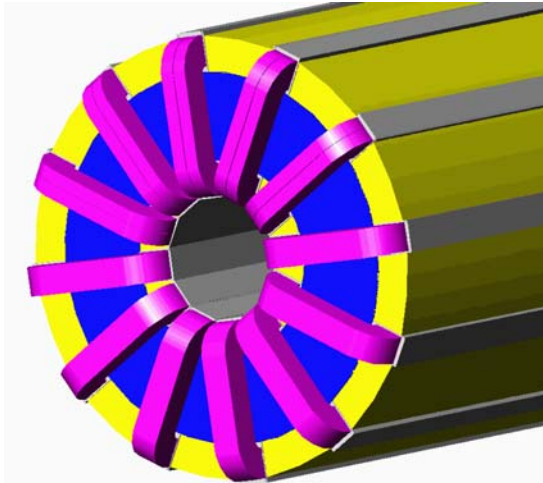
Courtesy T. Nicol

# Spool Design



Courtesy T. Page

# “Flat Coil Array” Design (V. Kashikhin)



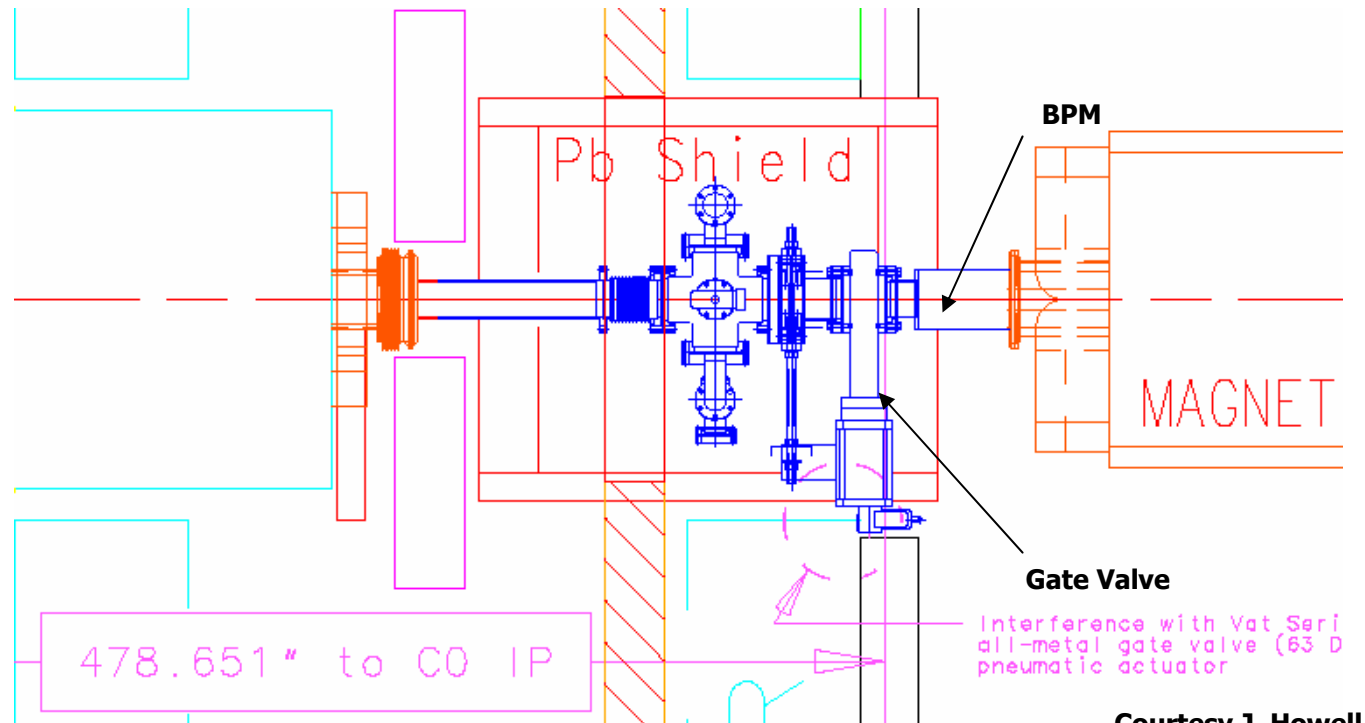
Integrated dipole field, T-m	0.48
Integrated quadrupole gradient, T	7.5 / 25
Integrated sextupole strength, T/m	450
Effective length, m	1.0 / 1.5
Inner coil radius, mm	40
Inner core radius, mm	63
Outer core radius, mm	120
Maximum current, A	50 - 55
Coil number of turns	850 - 930
Bare strand diameter, mm	0.5
Strand diameter with insulation, mm	0.63
Coil area, mm <sup>2</sup>	368
Cold mass outer diameter, mm	290

## Possible advantages

- **5(?) correctors/spool**
- **easier to fabricate (than  $\cos n\theta$  coils)**
- **stronger correctors**
- **reduces number of spool types (3)**
- **field quality under investigation**

# Interfacing at Collision Hall

- Beam valve agreed upon (standard VAT gate valve)
- “Keep Away” requirement has now been met (478.65”)
  - Likely we can gain even more space so that BV can move outward
- Accommodations will be made for the b2 magnets to be removed through the Tevatron tunnel in case of failure



Courtesy J. Howell

## **C0 → “Normal Straight Section”**

- **Can easily fit into an 8 week shutdown ('05)**
  - **Have had discussions with T Lackowski concerning scope of work and possible interference with “civil construction”**
  - **In C0 Collision Hall:**
    - 2 weeks to remove MI dipoles**
    - 5 weeks for LCW, power distribution, VESTA**
    - 1 week to install beampipe, bakeout, and pump down**



# Other Progress

- QPM tunnel layout (“QPM” = Quench Protection Monitor)
- QPM system design
- Detailed planning for converting C0 to normal straight section
- 3-D model from B43 to C17
- Cryogenic layout
  - moved Tev bus feedthroughs to reduce # of spool types to 3

# Project Status

- **Current level of support in AD is ~4 FTE's**
  - **Will increase by a few soon**
- **Current level of support in TD is ~3.5 FTE's**
  - **Will increase by a few soon**
- **Converging to a WBS**
- **Director's Review for C0 IR scheduled for ~Feb. 18-19**
  - **1<sup>st</sup> draft of Design Report will be presented**

# Proposed WBS Structure

	Level 2 Project		Level 3 Project		Level 4 Project			Level 3 Project		Level 4 Project
2.0	C0 IR									
		2.1	magnet fabricate				2.5	controls		
				2.1.1	LHC quads				2.5.1	new LB QPMs
				2.1.2	new spools				2.5.2	Tev QPM mods
				2.1.3	new separators				2.5.3	corrector PS's
		2.2	C0 --> normal straight						2.5.4	new collimators
				2.2.1	magnet moves				2.5.4	other ...
				2.2.2	LCW mods		2.6	instrumentation		
				2.2.3	synch light monitor				2.6.1	tunnel mods
				2.2.4	controls mods				2.6.2	software mods
				2.2.5	commissioning		2.7	tunnel installation		
		2.3	main power supplies						2.7.1	cryogenic elements
				2.3.1	10KA PS's @ C0				2.7.2	magnetic elements
				2.3.2	5KA PS's @ B4, C1				2.7.3	LCW modifications
				2.3.3	separator PS's				2.7.4	collimators
		2.4	cryogenic systems						2.7.5	separators
				2.4.1	cryogenic elements		2.8	beam commissioning		
				2.4.2	controls mods				2.8.1	develop commissioning plan
									2.8.2	operational software mods
									2.8.3	beam studies

# Design Report Outline

## Outline for C0 IR Design Report – version 1

M Church  
version 0 11/19/03  
version 1 11/25/03

Editor: M Church

- 1) Introduction – motivation, background, overview [M Church](#)
- 2) Accelerator physics [J Johnstone](#)
  - a. design issues, requirements, constraints, operating modes, operational requirements [J Johnstone](#)
  - b. overview of design: layout and lattice functions, beam envelopes, slot lengths, magnetic field specification [J Johnstone](#)
  - c. helix solutions for all modes [J Johnstone](#)
  - d. dynamic aperture, comparison with Run II lattice, field quality specifications [tbd](#)
  - e. beam loss/halo calculations and collimation scheme [tbd](#)
  - f. dipole correction circuit requirements [J Johnstone](#)
  - g. skew quad, sextupole, octupole, and feeddown circuit requirements [J Johnstone](#)
  - h. bpm requirements [J Johnstone](#)
  - i. alignment requirements [tbd](#)
  - j. emittance growth calculations, comparison with Run II lattice [tbd](#)

- 3) LHC style quads [J Kerby + designees](#)
  - a. Overview and conceptual design
  - b. Cable and steel specifications
  - c. Dimensional specifications
  - d. Field quality specifications
  - e. Electrical specifications
  - f. Cryogenic specifications
  - g. Support and alignment specifications
  - h. Quench protection requirements
  - i. Measurements and R&D to date
  - j. Tev bus pass through
  - k. Connections and interfacing
  - l. ....
- 4) New spools [J Kerby + designees](#)
  - a. Overview and conceptual design
  - b. Cable and coil specifications
  - c. Dimensional specifications
  - d. Field quality specifications
  - e. Electrical specifications
  - f. Cryogenic specifications
  - g. Power feedthrough specifications, R&D plans
  - h. Support and alignment specifications
  - i. Quench protection requirements
  - j. Tev bus pass through
  - k. Connections and interfacing
  - l. ....

# Design Report Outline (continued)

- 5) Power Supplies **D Wolff + designees**
  - a. Number and layout (including 50A supplies)
  - b. Buswork specification and layout **J Riordan**
  - c. Electrical specifications
  - d. AC power and LCW requirements
  - e. Controls specifications
  - f. B4 and C1 qpm specifications
- 6) Cryogenic Systems **A Klebaner**
  - a. Helium usage limitations
  - b. Cryogenic schematics
  - c. Cryogenic controls and software modifications
  - d. Specification of new cryogenic components
  - e. Interface specification
- 7) Vacuum Systems **R Reilly**
  - a. Layout
  - b. Requirements for cryogenic vacuum
  - c. Requirements warm vacuum
  - d. Requirements for isolation from C0 straight
- 8) Controls, beam instrumentation, and software **S Lackey**
  - a. Integration with current Tevatron systems (MDAT, abort loop, ...)
  - b. Low beta qpm system
  - c. Application software requirements
- 9) Commissioning **M Church and tbd**
- 10) Conversion of C0 region to “normal” straight section **P Garbincius**
  - a. Requirements, motivation, lattice changes
  - b. Installation work
    - i. Removing MI dipoles, C-mags **R Reilly**
    - ii. Modifying B4 and C1 layout **R Reilly**
    - iii. LCW requirements for C0 Collision and Assembly Halls **J Riordan**
    - iv. Controls, qpm, and software modifications **S Lackey, K Martin**
    - v. Power supply modifications **D Wolff or designee**
    - vi. Synch light modification **S Pordes**
- 11) Integration, installation schedule, and cost **P Garbincius, M Church, R Reilly**
  - a. Tunnel layouts **J Brandt**
  - b. Q1/TSP removal from A4,B1
  - c. Schedule
  - d. Cost

# Conclusions

- **Still looks good .....**
- **Building up strong teams in TD and AD ....**
- **Technical progress being made .....**